DETAILED ACTION

Examiner's Comment

An amendment, amending claim 1, was received and entered into the record on 7/30/2008.

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claims 1-3, 9-12 and 14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nguyen (US 6,013,399) in light of Nakamura et al. (US 5,429,730).

Claims 1-2: Nguyen teaches a method of forming a multi-layer work piece comprising a capping layer (Abst.) wherein the silicon capping layer is formed using vapor deposition (7:58-61) and explains that it is necessary to repair defects that appear in the capping layer (4:9-14) because defects in the multilayer mask negatively impact the reflectivity of the EUV mask (3:49-55). What it does not teach is the particular method used for correcting these defects. Nakamura teaches a method of correcting recessed defects (claimed pinholes) in a film (10:29-31) comprising the steps of placing a work piece with a defect into a chamber (see, e.g., Fig. 1), inspecting the work piece for defects (10:31-35), introducing a precursor gas into the area of the chamber (10:35-42; Fig. 1) and directing an electron beam at the defect to deposit the precursor material into the defect (10:35-49; for electron beam: 11:24-25) wherein the electron beam causes the precursor gas to dissociate (10:35-49; because Nakamura teaches that an Si-H precursor gas is used to form the silicon-containing deposit, the gas must be dissociated to form this material). Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have applied the method of Nakamura to the multilayer work piece of Nguyen in order to have corrected defects in the capping layer.

Claim 3: Nguyen also teaches that the corrected film comprises silicon (7:58-61).

Claims 9-10: Nguyen further teaches that the multilayer work piece is a multilayer mask blank (3:61-67).

With respect to Claims 11-12: Nguyen also teaches that the multilayer work piece is a EUV mask (3:61-67) comprising a reflective multilayer (3:49-51) wherein a capping layer is formed on top of the reflective multilayer (Fig. 6).

Claim 14: Nguyen further teaches that the absorbing layer and buffer layer are etched to pattern a desired mask (8:66-9:16; 9:66-67). With respect to re-inspecting the layer for defects and re-filling any defects found, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have repeated the steps in the combined method of Nakamura and Nguyen in order to have eliminated any and all defects discovered in the capping layer.

3. Claims 4 and 13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nakamura and Nguyen in light of Sherman (US 5,916,365).

Claims 4 and 13: Nguyen teaches all the limitations of claims 3 and 12 in light of Nakamura, as discussed above. Nakamura further teaches that the precursor gas used to fill the defect is a gas with Si-H bonds, but fails to expressly teach that said gas is silane (SiH_4). Sherman teaches that silane is a known precursor gas for forming elemental silicon (7:33-37). The selection of a known material based on its suitability for its intended use supported a prima facie obviousness determination in *Sinclair & Carroll Co. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945). Thus it would have been obvious to one of ordinary skill in the art at the time the invention was made to have used silane as the Si-H gas with the predictable expectation of successfully forming a silicon dioxide deposit.

4. Claims 5-6 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nguyen and Nakamura in light of Singh (US 6,449,086) and further in light of Marsh et al. (US 2002/0028556) with reference to Lutz (US 6,762,072).

Nguyen teaches all the limitations of claim 1 in light of Nakamura, as discussed above. What it does not teach is that the capping layer comprises ruthenium. Singh teaches a multilayer reflective work piece (3:3-9) comprising alternating layers of Mo and Si (4:26-28) with a capping layer on the reflective layers wherein the capping layer comprises ruthenium (3:49-55). The selection of a known material

based on its suitability for its intended use supported a prima facie obviousness determination in *Sinclair & Carroll Co. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945). Because both Nguyen and Singh teach substantially identical multilayer reflective work pieces, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have substituted ruthenium for amorphous carbon as the material used to form the capping layer.

Nguyen and Singh, however, fail to teach how defects in the capping layer are corrected. While Nakamura teaches a method for correcting these defects, it fails to teach that its method can be applied to correcting defects in a ruthenium layer. Marsh, however, teaches a method of depositing ruthenium using triruthenium dodecacarbonyl ($Ru_3(CO)_{12}$) as a ruthenium precursor (¶ 0040) in a laser assisted CVD process (¶ 0037). Furthermore, it is known in the art that laser assisted CVD and electron beam induced CVD are recognized equivalents (see, e.g., Lutz at 3:43-49). Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have used triruthenium dodecacarbonyl as the ruthenium precursor in order to have repaired defects in the ruthenium capping layer of Nguyen and Singh.

5. Claims 7-8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nguyen, Nakamura and Singh in light of Kaito (US 4,950,498).

Claims 1 and 7-8: Nguyen teaches all the limitations of claim 1 in light of Nakamura, as discussed above. What it does not teach is that the capping layer comprises carbon. Singh also teaches that the capping layer comprises carbon (3:49-55). Nguyen and Singh, however, fail to teach how defects in the capping layer are corrected. Kaito teaches a method of correcting recessed defects (claimed pinholes) in a carbon film by introducing a pyrene (claimed hydrocarbon) gas and irradiating the gas with a focused ion beam to dissolve the gas and form a carbon deposit (2:41-51). While Kaito teaches that this is accomplished with a focused ion beam, Nakamura explains that an electron beam can be used in the place of a focused ion beam, as discussed above. It would have been obvious to one of ordinary skill in the art at the time the invention was made to have applied the method of Nakamura to correcting defects in a carbon film, as taught by Kaito, with the predictable expectation of successfully correcting defects in the carbon film.

6. Claim 15 is rejected under 35 U.S.C. 103(a) as being unpatentable over Nguyen and Nakamura in light of Yan et al. (US 5,928,817).

Claim 15: Nguyen teaches all the limitations of claim 11 in light of Nakamura, as discussed above. Also, as discussed above, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have repeated the steps in the combined method of Nakamura and Nguyen in order to have eliminated any and all defects discovered in the capping layer. However, these references do not expressly teach that the EUV mask is cleaned. Yan, however, teaches a method of forming a multilayer reflecting mask with a capping layer (Abst.) and explains that the surface can be cleaned in order to extend the lifetime of the substrate (5:16-20). Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have cleaned the EUV mask in order to have improved the cleanliness of the process.

7. Claim 16 is rejected under 35 U.S.C. 103(a) as being unpatentable over Nakamura and Nguyen in light of Narui et al. (US 2004/0007722).

Claim 16: Nguyen teaches all the limitations of claim 11 in light of Nakamura, as discussed above. However, Nakamura fails to teach how the electron beam is generated. Narui teaches the use of an electron beam, wherein the beam is generated by an electron optical system (¶ 0505). Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have used an electron optical system to generate the electron beam because it is known in the art that this is a suitable means of generating an electron beam.

8. Claim 17 is rejected under 35 U.S.C. 103(a) as being unpatentable over Nguyen, Nakamura and Yan in light of Sakano et al. (US 2004/0007560).

Claim 17: Nakamura teaches all the limitations of claim 15 in light of Nguyen and Yan, as discussed above. What these references do not expressly teach, however, is that the growth rate is modulated by adjusting the voltage of the electron beam. Sakano teaches that, in a vapor deposition process, variations in the voltage are used to predict the amount of consumed material and the thickness of the deposited film (¶ 0032). Thus, it would have been obvious to one of ordinary skill in the art at the

time the invention was made to have varied the voltage of the electron beam in Nguyen and Nakamura in order to have controlled the growth rate of the defect deposit with the predictable expectation of success.

9. Claim 18 is rejected under 35 U.S.C. 103(a) as being unpatentable over Nguyen, Nakamura, Yan and Sakano in light of Kirkpatrick et al. (US 2002/0051846).

Claim 18: Nakamura further teaches that the voltage can be altered to affect the ability to deposit the material into a fine region (28:5-13). Furthermore, Kirkpatrick teaches that the diameter of a beam can be set by adjusting the voltage (¶ 0033). "[W]here the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation." *In re Aller*, 105 USPQ 233, 235 (CCPA 1955). Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have increased the voltage of the electron beam in order to have increased the spatial resolution of the filling with the predictable expectation of success.

Response to Arguments

10. Applicant's arguments filed 7/30/2008 have been fully considered but they are not persuasive.

Applicant argues that it is inappropriate to combine Nguyen with Nakamura because Nguyen only teaches the repair of particulate defects and that the combination would render Nguyen inoperable. This is not persuasive. Nguyen teaches that it is undesirable to have any type of defect in a capping layer of an EUV mask and does not limit this statement to particulate defects (see, e.g., 3:49-55). While Nguyen does discuss repairing particulate defects--as an example (see, e.g., 4:4-18)--disclosed examples and preferred embodiments do not constitute a teaching away from a broader disclosure or nonpreferred embodiments. *In re Susi*, 440 F.2d 442, 169 USPQ 423 (CCPA 1971). Therefore, the combination of Nguyen with Nakamura does not render the broad teaching of Nguyen inoperable and the combination is proper as applied above.

Conclusion

11. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date

of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to ROBERT VETERE whose telephone number is (571)270-1864. The examiner can normally be reached on Mon-Fri 9-6.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Michael Cleveland can be reached on 571-272-1418. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

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